

Far-lateral approach

The far-lateral [approach](#) is an extension of the standard [suboccipital approach](#), designed to maximize exposure of the lateroventral [craniocervical junction](#).

The increase of exposure for the bony and neurovascular tissues is not necessarily matched with the increase of surgical space. The volumetric comparative analysis is helpful to provide more detailed anatomical information in the surgical design ¹⁾.

Bone removal involves the most lateral part of the inferior occipital squama and the posterior arch of C1. Drilling of various portions of the occipital condyle further increases the exposure. Transposition of the vertebral artery is seldom required. The far-lateral approach allows a tangential, unobstructed view of the lateroventral cervicomedullary area and can be applied effectively to manage with a heterogeneous spectrum of pathological lesions involving this area ²⁾.

A standard far lateral [craniotomy](#) provides access to the [paracondylar](#) or supracondylar approaches. The paracondylar approach includes drilling of the jugular process in order to reach the region lateral to the condyle and jugular foramen. When there is an intention to reach the medial aspect of the hypoglossal canal and jugular tubercle, the supracondylar approach is the most adequate choice.

The far lateral [approach](#) is the one composed by the dissection of [suboccipital muscles-cervical muscles](#) with the exposition of [suboccipital triangle](#), the lateral [suboccipital craniotomy](#) and finally the exposure of [vertebral artery](#) since its entrance into the [dura](#) ³⁾.

History

In 1986, Heros ⁴⁾ introduced the [far-lateral approach](#) (FLA) for the management of the [vertebral artery aneurysms](#) (VA), the vertebrobasilar junction, and the proximal basilar trunk and for arteriovenous malformations of the inferolateral cerebellum.

In 1988, George et al. introduced the FLA for removal of lesions involving the anterior/anterolateral foramen magnum ⁵⁾.

Indications

The basic far-lateral exposure provides access for the following approaches:

- 1) The [transcondylar approach](#).
- 2) The [supracondylar approach](#) directed through the area above the occipital condyle
- 3) The [paracondylar approach](#) directed through the area lateral to the occipital condyle ⁶⁾.

It has been used to approach for the majority of the lesions located ventrolateral to the [brainstem](#) and in the upper cervical [spinal cord](#).

When the intention is reaching anterior and lateral medulla regions as in lower clivus tumors, inferior third basilar artery and vertebral basilar junction aneurysms this is the best choice ⁷⁾.

Technique

Consists into three steps. Performing a lateral suboccipital craniotomy, including the resection of atlas posterior arch, as the first step. Dissecting the muscles along the posterolateral aspect of the craniocervical junction to permit an adequate exposure of C1 transverse process and the suboccipital triangle, and, finally, perform an early identification of the vertebral artery into the suboccipital triangle.

This approach pursues to remove the [occipital bone](#) including the posterior aspect of the ipsilateral [occipital condyle](#) and posterior arch of C1. Anatomical landmarks may be recognized for the neurosurgeon to avoid neurovascular injuries, specially to the vertebral artery and hypoglossal nerve.

The occipital condyles are the contact area of the occipital bone with the articular aspects of C1. They present an inferior convex surface, and they are usually associated to a posterior foramen to the posterior condyle vein.

The hypoglossal canal penetrates the occipital condyle in its base. It presents a posterior to anterior and a medial to lateral orientation, where hypoglossal nerves cross and leave the intracranial compartment. The intracranial exit zone is 8mm ventral to the posterior aspect of the occipital condyle, and 21mm dorsal to the anterior aspect. The hypoglossal nerve is directed anteriorly and laterally at a 45-degree angle with the sagittal plane. The lateral aspect of the intracranial limit is reached removing approximately the posterior third of the occipital condyle.

Positioning

Park bench

see [Park bench position](#)

Semi sitting

see [Semisitting position](#)

Landmarks

Inion, asterion, C2 spinous process and mastoid apex should be marked.

We must identify three important landmarks: the external occipital protuberance, the mastoid process... and the transverse process of C1 which may be touched in the middle way between the mastoid tip and the posterior angle of the mandible.

Incision

The incision begins in the midline, approximately 5 cm below the inion and goes straight upward until 3 cm above the external occipital protuberance. Then it turns the incision laterally to the asterion and finally it turns downward and laterally over the [sternocleidomastoid muscle](#) posterior edge, approximately 5 cm below the mastoid apex. The use of bipolar coagulation helps to avoid bleeding of scalp arteries. The placement of wet gauze while applying traction of the scalp flap can spare the use of hemostatic clips and specific staples for this purpose.

Abundant irrigation of operative field with physiological solution is imperative for all long the procedure in order to avoid gaseous embolization.

Once it has been finished the scalp opening we can didactically divide the approach into three stages. There could be the muscular stage, vertebral artery exposition and craniotomy ⁸⁾.

Dissection

In the neurosurgical practice, the scalp and muscles are reflected together.

The muscle dissection is usually performed in one layer, but in this case layer-by-layer has been done for teaching purposes. Initially, after the skin and subcutaneous is everted, a superficial fascia is exposed, where the superficial occipital artery is located.

The sternocleidomastoid, laterally, and trapezius muscle, medially, constitute the first muscular layer. The sternocleidomastoid muscle presents superiorly an attachment in the mastoid tip and in the lateral part of the superior nuchal line, and it is directed downward and anteriorly to the clavicle and the manubrium sterni. The trapezius muscle is attached in the superior nuchal line, the external occipital protuberance and the posterior cervical ligament.

The splenius capitis muscle is located under the sternocleidomastoid muscle. It is attached in the mastoid tip and is directed downward and medially to the inferior half of the ligamentum nuchae. The semispinalis capitis muscle is located medially and under the splenius capitis muscle. It is attached between the superior and inferior nuchal lines and courses inferiorly to the transverse process of C4, C5 and C6.

The occipital artery is visible after detaching the splenius capitis muscle. It is a branch from the external carotid artery, and it usually emerges 20 mm further the carotid bifurcation at the level of the angle of the mandible. It ascends and goes backward, first between the [rectus capitis lateralis](#) and later between the superior oblique and the posterior aspect of the digastric muscle. It is accompanied by the occipital vein. It presents two possible ways according to the presence of the occipital groove, located medial to the mastoid notch. If it is absent, the artery courses superficial to the longissimus capitis muscle or coursing deeply to it if the groove is patent.

The suboccipital triangle is covered by a layer of dense fibrofatty tissue. It is formed superolaterally by the superior oblique muscle and inferiorly by the inferior oblique muscle, and medially by the rectus capitis posterior major. It contains the horizontal portion of the vertebral artery and the C1 nerve, lying in a groove on the upper surface of the lateral part of the posterior arch of the atlas.

The segment of the vertebral artery located between the C1 transverse process and the dural entrance gives rise to muscular branches and the posterior meningeal artery, which can be safely

coagulated. The PICA occasionally arises extradural and could be inadvertently injured.

The vertebral artery transposition makes the condylar drilling easier and safer. For the vertebral artery transposition is necessary to open the foramen transverse of C1 and mobilize the artery inferomedially .

The suboccipital craniectomy is performed from the inferior nuchal line, superiorly, to the posterior rim of the foramen magnum, inferiorly, and up to the occipital condyle laterally .

A curvilinear incision of the dura is performed just from behind of the sigmoid sinus to the C2 lamina, and it is reflected and held medially and laterally with sutures. The opening may be extended up to the junction of sigmoid and transverse sinus if cerebello-pontine angle has to be approached.

Although the dural opening is performed after drilling of the occipital condyle, it has been opened before to expose the neurovascular structures. The hypoglossal nerve arises from the preolivary sulcus and runs laterally to the hypoglossal canal. From this view, the hypoglossal nerve is covered by the roots of the [accessory nerve](#).

The posterior condylar [emissary vein](#), which travels from the jugular bulb to the extradural venous plexus, may be injured and hemostasis, if it is necessary. The degree of occipital condyle removal vary widely, although posterior and medial one third of the condyle usually is enough for ventrolateral tumors. If more than 50% of the condyle is resected, the craniovertebral junction becomes unstable, and occipitocervical stabilization is required.

1)

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